

## Comments on the proposed amendments to UN Regulation No. 110

The text below has been prepared by the expert from NGV Global in response to amendments proposed at the 112<sup>th</sup> Session of the GRSG from Germany (GRSG 112-33) and Italy (GRSG112-28). These relate to issues associated with the testing and inspection of CNG cylinders.

Two amendments to UNECE Regulation 110 regarding inspection and testing of CNG cylinders have been proposed at the Working Party on General Safety in April 2017 (GRSG-112); one from Italy and the other from Germany.

NGV Global offered to provide input and expertise that addresses the concerns of these Contracting Parties to create a reasonable resolution to inspection and testing procedures of CNG cylinders. NGV Global has reached out to a wide variety of NGV stakeholders (members and others), with a focus on cylinder manufacturers and regulators: twelve CNG cylinder manufacturers in Europe, North and South America resulting in responses from seven experts in six companies; NGV Global technical committee experts; two branches of TUV in Germany; the Canadian Standards Association; and the NGV associations in the U.S. and Europe. A collaborative effort has been sought in order to obtain information and input to suggest improvements to the German and Italian proposals for the GRSG-113 meeting in October 2017.

### SUMMARY OF PROPOSED AMENDMENTS<sup>1</sup>

- **Visual inspection of CNG cylinders (type not specified), Germany.** (Germany Informal document GRSG-112-33) Germany is proposing an amendment to R.110 paragraph 18.1.6.1, to perform visual inspection of cylinders without removing protective covers of the CNG cylinders. New designs for a wide range of cylinder protective covers would be required to fulfill the terms of this proposed amendment.

*Notwithstanding the provisions of paragraph 18.1.6., sufficient access to the CNG-cylinder/LNG-tank and their accessories shall be ensured for visual (periodical) inspection, **without the necessity of disassembling any components or part of protective housing.***"

Germany expressed concern about corrosion due to incidents in Germany and other parts of the world that have led to destructive events involving CNG cylinders.

The rationale section presents the nature of the challenge for both OEMs and retrofitters of NGV systems: *"The proposal aims in meeting both the requirement of adequate protection, but also in guaranteeing sufficient access to the cylinder and its accessories to allow regular visual inspection. The access can be realized e.g. by an inspection hatch in the housing."*

- **Visual inspection of CNG cylinders, Italy.** (Italy Informal Document GRSG-112-28) Italy indicated that there are no "new issues" but that clarifications regarding cylinder inspection are required due to recent NGV incidents in Italy. Italy proposed that cylinder inspection must be done under any cover that fits over the dome end of the cylinder. They suggest changes in Annex 3A.

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<sup>1</sup> Note: Apart from the headings, **text in bold** represent the proposed changes to the existing regulatory text.

paragraph 4.1.4 (periodic requalification) saying, "Each cylinder shall be visually inspected at least every 48 months after the date of its entry into service on the vehicle (vehicle registration) and at the time of any reinstallation to verify the absence of damage and deterioration, including under the support straps **and under any protective covers of the dome end** (of the cylinder)." (The word 'ogive' originally appeared as a mis-translation in the document that instead should be referred to as the 'dome end' of the cylinder.)

- **Testing of CNG cylinders, Italy.** Italy also advocated a change in the testing procedure language that would require the removal of any covers on the dome-end of the cylinders. Italy also proposed to add in Annex 3A a new paragraph **10.7.5 Impact damage test. "One or more finished cylinders must be subjected to an impact damage test according to paragraph Appendix A, paragraph A.20. When protective covers on the dome are fitted on the cylinder, this test shall be carried out in the absence of such covers."**

## THE SITUATION

Both proposals have undisputed merits in that they intend to promote safety of in-use CNG cylinders through improved inspection techniques and procedures. Paradoxically, however, the proposals contradict one another. Germany proposes that installers of vehicular CNG cylinders create new designs for protective covers or 'housing' (both terms need clarifying definitions) that provide visual access to the cylinders in-situ but without removing the protection systems. Italy proposes that CNG cylinders with covers on the dome end of the cylinders – Types III and IV – and the straps/brackets that keep the cylinders in place be removed for the periodic visual inspection. Achieving both these objectives is not possible in the current language of the amendments.

- **Not all CNG cylinder protective systems are suited to providing visual access without mechanical (e.g. with tools) removal.** There are a wide range of cylinder protective systems (covers and housings) that differ for buses, heavy trucks, medium/light duty trucks and light duty vehicles. Many retrofit NGV systems with the cylinders in the trunk/boot of a passenger car or in the cargo area of a commercial vehicle typically do not have or need protection since they are 'inside' the vehicle and are not subject to travel-related damage.
- **ISO requires cylinders designed with end caps to be tested with them installed.** Some cylinder caps are integrated into the cylinder ends beneath the fiber wrap. Others are designed with caps added to the ends and fixed with adhesive. ISO 11439 "*Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles*" stipulates in Annex A(20), "For type 3 and type 4 designs, one or more finished cylinders (including end caps that are part of the design) shall be tested...." Some cylinder manufacturers provide protective caps on the cylinder ends only for transport to the ultimate customer. In these cases the caps are not integral to the design of the cylinder, therefore, are not part of the cylinder test certification and are made for removal when the cylinder is installed on the vehicle.
- **Cylinder periodic inspection procedures are inconsistent country-by-country and even intra-country.** The knowledge, experience and training of inspectors differ vastly. As such the quality of cylinder inspections also varies widely. Some inspections are conducted by official government vehicle inspection authorities but they may not be familiar with NGVs/CNG due to the low volume of vehicles. OEM mechanics are trained and tend to be more familiar with their vehicle products but not all of these are approved to inspect and perform safety certification of cylinders on behalf of a government authority. The Italian government authority, Gestione Fondo Bombole Metano (GFMB) retests hundreds of

thousands of cylinders annually and may be unique amongst governments in their collective expertise for re-testing CNG cylinders. Furthermore, many cylinder manufacturers do not provide their testing requirements and manuals to government cylinder inspectors (as required).<sup>2</sup> This exacerbates the inspection process, further complicated by the range of types and sizes of cylinders whose inspection cannot be treated in the same manner.

- **The timing of interval visual inspections remains an issue.** R.110 originally required re-inspection of cylinders every three years but this was amended due to Italian concerns and the timing of their vehicle inspections to every four years. Experts indicate that it might be appropriate to do visual inspections more frequently; possibly at the time of the normal vehicle road-worthy inspection required by most governments (this can vary from every one-to-four years).

## DISCUSSION AND INPUT FROM EXPERT STAKEHOLDERS

### *Comments applying generically to both amendments*

- **Specify cylinder types.** Neither proposal specifies which types of cylinders might apply in each amendment. Germany is concerned about corrosion but this is only applicable for Types I and II cylinders. Types III and IV cylinders are not subject to corrosion but they are prone to scuffing, cuts and impact damage. Italy addresses caps on the cylinder dome ends but these are only characteristic of Types III and IV composite cylinders.
- **Re-test versus periodic visual inspection.** Cylinder re-testing as done by GFBM in Italy is a much more comprehensive testing regime whereby cylinders are removed from the vehicle. (There are, however, divergent expert opinions about the necessity and utility of some of the re-testing requirements.) Re-testing of cylinders after a vehicle accident/incident is similar. It is generally acknowledged by multiple experts that visual inspections which, if done properly, can adequately insure the safety of cylinders throughout their lifetime. The two amendments should take care to distinguish between *re-testing* and *periodic inspection*.
- **No damage to the covers, no damage to the cylinders.** Some experts indicated that if there is no damage to the dome covers on Type III and IV cylinders then damage to the dome itself is unlikely. Experts have made this same argument for covers on Types I and II cylinders, however, in the case of corrosion, damage to the exterior of a cylinder may be concealed despite the covers being in good condition. This increases the need for visual inspection, however, removal of the covers or the housing would be required in the case of most of the currently designed CNG storage and protective systems.

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<sup>2</sup> R.110, Annex 3a, paragraph 4.1.4 Periodic Inspection: Recommendations for periodic requalification by visual inspection or testing during the service life **shall be provided by the cylinder manufacturer on the basis of use under service conditions specified herein.** Each cylinder shall be visually inspected at least every 48 months after the date of its entry into service on the vehicle (vehicle registration), and at the time of any reinstallation, for external damage and deterioration, including under the support straps. The visual inspection shall be performed by a competent agency approved or recognised by the Regulatory Authority, **in accordance with the manufacturer's specifications:** Cylinders without label containing mandatory information or with labels containing mandatory information that are illegible in any way shall be removed from service. If the cylinder can be positively identified by manufacturer and serial number, a replacement label may be applied, allowing the cylinder to remain in service.

## *Comments specific to the Italian proposal*

Collective comments about removal of the dome covers on Types III and IV cylinders are summarized by two responding experts:

“We understand Italy’s concern, especially if the dome protection is added after the manufacture of the container or in the field and that the dome protection could conceal existing damage to the container. We would suggest that any dome protection that is included with the container must be installed at the factory and, whether it is external to the wrap or integrated under the wrap, should be subject to all qualification and batch testing of the container. We feel that any attempt to remove dome protection after installation to the container could damage external fibers, thus creating an unsafe condition. In regard to the drop test, we maintain that containers need to be tested in the condition in which they will see service.”

“Removal of the dome covers would not be appropriate, as the cylinders are drop tested during certification with the protection in place, so any removal would alter the conditions after the test.”

## **RECOMMENDATIONS**

### *Regulatory proposals of Germany and Italy*

NGV Global is not making specific recommendations regarding changes to the language in the German or Italian proposed amendments. The intentions of both are well-conceived. But because their approaches are contradictory, it is best for the Contracting Parties to first resolve their mutual concerns about cylinder safety so that compatible recommendations can be developed as to how, in their view, in-situ visual inspections of cylinders are to be handled. Any requirements to facilitate the visual accessibility of vehicle-mounted CNG cylinders by altering the design of protective coverings would be a welcome contribution to the NGV industry worldwide. This assumes, however, that the regulation would not cause short term or medium term disruption of the NGV market due to new design criteria for cylinder covers. Such requirements would apply to those cylinder manufacturers that provide covers (for example dome covers) but also to vehicle manufacturers and retrofit installers who might make protective cylinder covers and housings.

As for Italy’s proposal, it is clear from manufacturers’ comments and ISO 11439 A(20) (from which R.110 language was ‘borrowed’) that removing the dome covers that are part of the certified CNG storage system is potentially destructive to the integrity of Type III or Type IV cylinders and should not be a regulatory requirement. Likewise, any prescriptive regulation to alter testing procedures that causes multiple cylinder manufacturers to alter their well-established cylinder designs is likely to cause disruption in the industry. Such an unintended consequence of an amendment should be avoided.

### *Achieving collaborative, consensus resolution to safety concerns of government & industry*

NGV Global seeks to obtain broad support for creating a task force or informal working group to address the issues of CNG cylinder inspection from a global perspective, to include the views of different international and national standards organizations (for example UNECE/GRSG, ISO, CSA, NFPA and FMVSS), governments, manufacturers and expert stakeholders.